

INHERITANCE OF SOME REPRODUCTIVE CHARACTERS IN HALF-BRED JERSEY FIRST CALVERS OF EASTERN ORISSA

THESIS

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C E R T I F I C A T E

This is to certify that the thesis entitled
"INHERITANCE OF SOME REPRODUCTIVE CHARACTERS IN HALF-BRED
JERSEY FIRST CALVES OF EASTERN ORISSA" is an independent
and original piece of work carried out by Dr. B.K.Sahoo
under our guidance and supervision.

It is further certified that no part of the
thesis has been submitted earlier for any degree or diploma.


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CHAPTER-I
INTRODUCTION

INTRODUCTION

People and the Government, both in private and public sector have realised the importance of improved dairying which has been reflected in Government's planning for economic development through various schemes. Cross-breeding of the native indigenous cattle with the exotic breeds is practised extensively to improve the milk production potentiality of these animals in a minimum time.

Introduction of exotic germ plasma commonly from Jersey breed has been started in Orissa as a Government endeavour in Intensive Cattle Development and Key Village zones, since 1975. Large number of Jersey halfbreeds have been generated and available with the private as well as Government sector. Studies on the growth, production and reproduction potentialities of these animals specially at the farmer's door have not been conducted mostly due to lack of organised data keeping. Misconceptions and sometimes overestimations originate among the people due to inadequate and improper observations on the performance of crossbreeds. There is a feeling among the cow owners that crossbred animals experience more reproductive difficulties than the deshi cows.

Expression of the genotype is always associated with its specific environment. In order that the high productive and reproductive potential of crossbreds be realised, improved and adequate feeding, management and disease control measures are essential during the growth and production period. This has been tried through the implementation of Crossbred Calf Rearing scheme, a part of Special Livestock Production Programme at farmers level in the Intensive cattle development areas of Puri district among other places of Orissa. Informations on the crossbred heifers included in the scheme, hopefully, do not suffer from the ill effects of underfeeding and malnutrition during the growth period and therefore, are expected to reveal the real potentiality for reproductive traits after analysis.

The present investigation was therefore, carried out on these animals with the following objectives.

- (i) To study the performance potential of the halfbred heifers for the available traits of reproduction at the farmer's door.
- (ii) To study the inheritance and association among the above traits and the possibility of improvement through selection.

CHAPTER-II
REVIEW OF LITERATURE

REVIEW OF LITERATURE

Heritability estimates

The heritability indicates the chance of improvement in a trait through selection. The various reports on the heritability estimates of reproductive characters, considered in the present study were reviewed below, traitwise.

Age at first service, conception and calving

Nagarankar (1964) observed the heritability of age at first calving to be 0.40 ± 0.15 , estimated by intra class correlation method in 405 Italian Friesian cows where as, Nathur and Roychoudhury (1971) reported it to be 0.164. Silva (1977) reported the heritability of the same trait in Holstein cows to be 0.16 while it was observed by Jabona *et al.* (1982) to be 0.14 ± 0.06 in the same breed.

Compere (1965) estimated the heritability of age at first conception by paternal half-sib correlation method and reported it to be 0.636 ± 0.352 in Kuanda cattle of Nyaminyaga.

Rosa *et al.* (1968) observed the heritability of age at first calving to be 0.16 in Brown Alpine cows.

Alin (1972) reported the heritability of age at first calving to be 0.52 ± 0.49 in American Brahman cattle.

In Pittanguerias cattle of Brazil, Lobo (1976) reported the heritability of age at first calving, using unadjusted and adjusted data for the year of calving to be 0.79 and 0.24, respectively whereas, Lobo and Duarte (1977) observed the values to be 0.78 and 0.24, respectively by half-sib correlation method.

Mabrouk (1977) reported the heritability of age at first calving to be 0.29 and 0.27 in German Black Pied and Simmental heifers, respectively.

In Guerensey cows, Silva (1977) reported the heritability of age at first calving to be 0.16.

Silva (1977) studied the heritability of age at first calving to be 0.16 whereas, Anand and Galaine (1981) reported the heritability of age at first service and calving to be 0.39 ± 0.16 in Jersey cows.

Thomas (1977) observed the heritability of age at first calving to be 0.63 ± 0.35 estimated by half-sib

correlation method whereas, Thomas and Choudary (1982) reported it to be 0.63 ± 0.35 in Red Dane Cattle.

In 240 Guzerat heifers of Brazil, Campos *et al.* (1981) reported the heritability of age at first calving to be 0.15 ± 0.18 .

The heritability of age at first calving reported by Campos *et al.* (1981) was 0.15 ± 0.24 in Gyr cattle of Brazil. Lobo *et al.* (1983) observed it to be 0.91 ± 0.20 by halfsib correlation method in the same breed.

Batra and Desai (1964) estimated the heritability of age at first calving by half-sib correlation method to be 0.504 ± 0.194 whereas, Nagpal and Acharya (1970) reported the same to be 0.46 ± 0.18 in Sahiwal cattle. Lower estimates for this trait were reported by Gopal and Chhatnagar (1971) by intrasire regression of daughters on dam (0.186) and Tomar *et al.* (1974) by sib correlation method (0.24).

The heritability estimates for the age at first calving in Mariana breed were 0.075 (Choudhary *et al.* (1965), 1.43 ± 0.82 (Chandiranani and Dadlani, 1967), 0.38 ± 0.11 (Guha *et al.*, (1968), 0.63 ± 0.16 (Singh *et al.*, 1968) 0.15 ± 0.03 (Dadlani *et al.*, 1969) 0.36 ± 0.12 (Soof and Singh, 1970), 0.04 (Balaino, 1971), 0.65 (Shoke *et al.*, 1974)

0.33 (Tanar et al., 1976) 0.40 ± 0.22 (Mishra et al., 1980) 0.26 ± 0.07 (Anand and Balaine, 1981), 0.29 ± 0.08 (Kumar, 1982) and 0.24 ± 0.02 (Jagan and Tanar, 1983).

Dutt and Singh (1972) reported the heritability of age at first calving to be 0.20, 0.18, and 0.24 estimated by simple regression of daughters on dams, intra-sire regression of daughters on dams and paternal halfsib correlation methods, respectively in Hariana cattle.

Arora (1981) estimated the heritability of age at first calving to be 0.31 ± 0.04 and 0.60 ± 0.15 by intra-sire regression of daughters on dams and halfsib correlation methods, respectively in Hariana cattle.

Singh and Sandaresan (1969) observed the heritability of age at first calving to be 0.32 ± 0.16 and 0.35 ± 0.54 , estimated by intra-sire regression of daughters on dams and intra-sire dam-daughter correlation methods, respectively in Tharparker cattle.

The heritability of age at first calving was reported by Dass et al. (1971) to be 0.08 ± 0.03 , Reddy and Bhatnagar (1971) to be 0.11 ± 0.09 , Prasad and Prasad (1972) to be 0.08, Majumdar and Prasad (1974) to be 0.20, Kumar (1982) to be 0.33 ± 0.12 and Parmar and Johar (1982) to be 0.16 ± 0.02 in Tharparker cattle.

Sukla and Prasad (1971) observed the heritability of age at first calving to be 0.256 ± 0.072 estimated by intra-sire regression method in Gir cattle whereas, Solanki *et al.* (1973) estimated the heritability of this trait to be 0.94 in 224 Gir cows over a period of 11 years. Singh *et al.* (1981) reported the value to be 0.20 ± 0.11 in the same breed.

Venkateswarlu *et al.* (1972) reported the heritability of age at first calving to be 0.77 ± 0.26 in Ongole cattle of Andhra Pradesh.

Patro and Rao (1983) observed the heritability of age at first calving to be 0.46 ± 0.28 and 0.24 ± 0.18 by paternal halfsib correlation and intra-sire regression of daughters on dams methods, respectively in a herd of Red Sindhi cows maintained at the Government dairy farm, Cuttack.

Singh and Prasad (1969) estimated the heritability of age at first calving to be 0.550 ± 0.338 and 0.545 ± 0.370 by intra-sire dam-daughter regression and intra-sire dam-daughter correlation methods, respectively in a herd of Barchaur cattle of Bihar.

Naidu and Desai (1985) reported the heritability of age at first calving to be 0.113 ± 0.020 in North-Indian Holstein x Sahiwal cattle.

Jasu and Ghal (1977) reported it to be 0.47 whereas, Tomar and Tomar (1982) reported it to be 0.76 ± 0.15 in 6/16 Sahiwal - 10/16 Holstein Friesian cows.

In 3/4 Zebu - 1/4 Holstein Friesian heifers of Gaba, Menendez et al. (1977) reported the heritability of age at first conception and calving to be 0.14 and 0.24, respectively.

Anand and Dalaine (1981) reported the heritability of age at first service and calving to be 0.39 ± 0.16 in Jersey x Hariana cattle.

Patel and Fareh (1982) estimated the heritability of age at first conception and calving by paternal halfsib correlation method in Jersey x Gir cattle to be 0.11 ± 0.21 and 0.24 ± 0.20 , respectively using data adjusted for nongenetic sources of variation. The same authors in 1982 reported the heritability of age at first conception and calving to be 0.11 ± 0.21 and 0.24 ± 0.20 , respectively by paternal halfsib correlation using data adjusted for nongenetic sources of variation in Holstein-Friesian x Gir cattle.

Insemination period and number of services per conception

In Friesian Cattle, Hegnoni and Setta (1960) observed the heritability of number of services per conception

to be 0.04. Capitelli *et al.* (1975) reported the estimate to be 0.05 and Silva (1977) studied it to be 0.05 while, Costa *et al.* (1982) estimated it to be $-.09 \pm 0.11$

Rognoni *et al.* (1966) reported the heritability of number of services per conception to be 0.24 in dairy cattle of Milan.

Silva (1977) reported the heritability of insemination period to be 0.06, both in Guernsey and Jersey cattle.

Milagres *et al.* (1979) reported the heritability of number of services per conception to be 0.64 ± 0.29 in Hereford heifers.

In Indian dairy cattle, Legates (1954) reported the heritability of number of services per conception to be 0.026.

Singh *et al.* (1968) observed the heritability of number of services per conception to be $-.06 \pm 0.10$, estimated by halfsib correlation method whereas, Toner *et al.* (1976) reported it to be 0.38 in Mariana cattle.

In Therparker cattle, Majumdar and Prasad (1978) reported the heritability of insemination period to be 0.03.

Gestation period

In a herd of Khertoun cattle of Alexandria, Alin (1964) reported the heritability of gestation period to be 0.29 by paternal halfsib correlation.

In dairy cattle of Utrecht, Banerjee-Schotsman (1964) observed the heritability of gestation period of first, second and third pregnancy to be 0.34, 0.57 and 0.53, respectively involving male calves and 0.42, 0.36 and 0.36 respectively involving female calves estimated by paternal halfsib correlation. He also observed it to be 0.44 and 0.52 in male and female calves, respectively in all pregnancies by sire-progeny regression.

In charolais cattle, Vianna et al. (1964) reported the heritability of gestation period to be 0.37, calculated by intrasire correlation.

In Meuse-Rhine Yssel cattle, Banerjee-Schotsman (1965) observed the heritability of gestation period to be 0.40.

Everette and Hagee (1965) reported the heritability of gestation period to be 0.10 in dairy cattle of Lansingh.

In Holstein-Friesian cattle, Plum et al. (1965) observed the heritability of gestation period to be 0.60 ± 0.12

after the data were adjusted for the effect of herd, sex, parity, year and season. Ma and Chyr (1976) reported it to be 0.12. Torres *et al.* (1976) estimated the heritability of this trait by paternal halfsib correlation method to be 0.34 whereas, Silva (1977), Bogacar (1980) and Costa *et al.* (1982) reported it to be 0.22, 0.04 ± 0.03 and 0.10 ± 0.10 , respectively in Holstein-Friesian cattle.

In Belgian cattle, Hasset (1966) reported the heritability of gestation period to be 0.10 and 0.11 involving male and female calves, respectively.

Vos *et al.* (1966) estimated the heritability of gestation period to be 0.22 and 0.37 involving male and female calves, respectively for dams aged more than 2 years 8 months whereas, the same was 0.28 and 0.27, respectively for dams aged below 2 years 8 months in Black Pied cattle.

In Brown Swiss cattle, Kondrasev (1968) reported the heritability of gestation period from sire component and dam \times interaction component to be 0.148 and 0.436, respectively.

Piorentini *et al.* (1969) observed the heritability of gestation period to be 0.20 in Aosta cattle.

Lampo and Willems (1969) estimated the heritability of gestation period by dam daughter correlation involving

male and female calves to be 0.30 and 0.18, respectively. whereas, the same estimated from half-sib correlation were 0.53 and 0.50, respectively in East Friesian Red Fied cattle.

In Simmental cattle, Misostova (1969) reported the heritability of gestation period to be 0.18 whereas, Pogacar (1980) observed it to be 0.95 ± 0.16 .

In Czech Fied cattle, Miksik *et al.* (1971) reported the heritability of gestation period to be 0.71 estimated by half-sib correlation method.

Nanrique *et al.* (1976) observed the heritability of gestation period to be 0.37 whereas, Silva (1977) reported it to be 0.22 in Jersey cattle.

In Ayrshire cattle, Laird and Hunter (1977) estimated the heritability of gestation period to be 0.24 ± 0.05 .

Silva (1977) calculated the heritability of gestation period to be 0.22 in Guernsey cattle.

In Slovenian Brown cattle, Pogacar (1980) observed the heritability of gestation period to be 0.05 ± 0.18 .

In Gyr cattle of Brazil, Lebo *et al.* (1983) reported the heritability of gestation period to be 0.31 ± 0.14 , estimated by half sib correlation method.

Sharma and Prabhu (1968) reported heritability of gestation period to be 0.66 ± 0.09 for female births in Kanku cattle.

Rao and Taylor (1971) observed the heritability of gestation period to be 0.06, 0.11 and 0.23, estimated from dam-daughter regression, dam-daughter correlation and paternal halfsib correlation, respectively in Ongole cattle.

Moulick and Syrstad (1973) reported the heritability of gestation period to be 0.14 in Jersey x Mariana cattle.

Jastidas et al. (1980) estimated the heritability of gestation period to be 0.33 ± 0.20 in F_1 Hollore x Brahman cattle.

Correlation

The correlation between traits indicated the chance of improvement of traits by way of selection. The various reports on phenotypic, genetic and environmental correlations between reproductive traits, considered in the present study, were reviewed below traitwise from the literature.

Age at first service and other reproductive traits

Trbojevic et al. (1968) observed the phenotypic correlation between age at first service and number of services per conception to be 0.66 in Seigrade cattle whereas, Silva (1977) reported phenotypic correlation of age at first service and insemination period to be 0.34 in Jersey, Holstein-Friesian and Guernsey cattle.

Age at first calving and other reproductive traits

Wilcox (1968) observed the phenotypic correlation of age at first calving with gestation period to be 0.22 whereas, Silva (1977) observed the correlation between age at first calving and insemination period to be 0.34 in Jersey cattle.

Wilcox (1968) found the phenotypic correlation of age at first calving with gestation period to be 0.25 in Holstein-Friesian cattle while Ma and Ghyr (1976) observed it to be very small and negative. Vecchiotti and Gappa (1976) observed the phenotypic correlation of age at first calving with number of services per conception to be -.12 whereas, Silva (1977) reported the correlation of age at first calving with insemination period to be 0.34.

Ma and Ghyr (1976) reported the phenotypic correlation of age at first calving with gestation period to be very small and negative in Brown Swiss cattle.

Singh *et al.* (1968) and Tomar *et al.* (1976) reported the phenotypic correlation of age at first calving with number of services per conception to be 0.29 ± 0.04 and insignificant, respectively, in Hariana cattle.

Tomar *et al.* (1976) reported genetic correlation of age at first calving with number of services per conception to be insignificant in Hariana cattle.

CHAPTER - III
MATERIALS AND METHODS

MATERIALS AND METHODS

Source of data

The data over a period of four years (1976-1979) on 386 halfbred Jersey first calvers, progeny of 30 sires were available for analysis. The animals belonged to ten livestock aid centres of Pipli block included within the calf rearing programme of Puri district.

History

The Crossbred Calf Rearing Programme, a part of the Special Livestock Production Programme of Government of India, had started its operation in Puri district since 1975. The aim of this programme was to motivate the rural poor farmers to rear the halfbred Jersey female calves from one month of age till their age at first calving on a loan cum subsidy basis in optimum feeding, breeding, disease control and managerial conditions. Under this programme the halfbred Jersey female calves that were produced in Pipli Intensive Cattle Development zone through artificial insemination were first identified and enrolled under the scheme following the norms and conditions of the programme.

Feeding, management, disease control and breeding

The female calves were supplied with balanced feed from one month till 28 months of age or date of first calving whichever is earlier as per the following feeding schedule.

Age of calf/Heifer in months	Prepared feed supplied per day
(i) 1 to 3	400 gms.
(ii) 3 to 5	600 gms.
(iii) 5 to 6	1 Kg
(iv) 6 to 13	1.5 Kg.
(v) 13 to 24	2 Kgs.
(vi) 24 to 28 or date of first calving which ever is earlier	2.5 Kgs.

Regular health check up, deworming, vaccination against H.S., J.Q., Anthrax, R.P., F.M.D. etc. was followed.

The farmers were also imparted with proper education of better managerial practices like hygiene and sanitation, exercise, regular brushing and bathing of animals etc. through public meetings, cattle shows and demonstrations.

Sexual health check up and subsequent treatment, if necessary, was also conducted through monthly ambulatory infertility clinics. Artificial insemination of the matured animals with liquid/frozen semen was taken up by the trained personnels.

Traits considered for analysis

The following reproductive traits were considered for the present study:

- (i) Age at first service: The period from date of birth to the date of first insemination.
- (ii) Age at first conception: The period from date of birth to the date of first conception.
- (iii) Age at first calving: The period from date of birth to the date of first calving.
- (iv) Insemination period: The period from date of first insemination to the date of first conception.
- (v) Number of services per conception: The number of inseminations required for first conception.
- (vi) Gestation period: The period from date of first conception to the date of first calving.

Correction of data

To eliminate the effect of year, the data were corrected as follows:

The observations were corrected for the effect of year by studying the significance of the year effect through

analysis of variance (one way classification). Constants for each year were obtained and used on the individual observations for correction in the following way.

$$x = X - (\bar{X}_i - \bar{X})$$

where,

x = Corrected individual observation

X = Uncorrected individual observation.

\bar{X}_i = Mean of the i th year

\bar{X} = Average of the year means

As the number of services per conception was in whole numbers and the number was also less than 10 in all cases, square-root transformation of the observations was followed before actual analysis.

Estimation of genetic parameters

Analysis of variance was conducted to estimate the different variance components. Each variable was described by the following linear statistical model.

$$Y_{ij} = \mu + S_i + e_{ij}$$

Where

i = 1, ..., S sires.

j = 1, ..., n_i progeny per sire

Y_{1j} = Record of the j th progeny of the i th sire

μ = The fixed underlying population mean

S_i = The effect of the i th sire

e_{1j} = The deviation of the individual j from the mean of the i th sire.

Assumptions on the distribution of effects

$S_i = N(0, \sigma_s^2)$ (random)

and $e_{1j} = N(0, \sigma^2)$ (random) (Uncontrolled, uncorrelated random effect that varied among the progeny of the i th sire)

(S_i) and (e_{1j}) were assumed to be independent and uncorrelated.

Test of hypothesis

$$H_0 : \sigma_s^2 = 0$$

v_s

$$H_A : \sigma_s^2 \neq 0$$

α (Probability level for statistical significance chosen a priori set at 0.05)

Test rejected H_0 if $F_{v_1, v_2} \text{ Calc.} > F_{v_1, v_2} \alpha$

The expectations of the mean squares (MS) for the assumed random effects model were of the form as shown in Table-1.

TABLE 1. Analysis of Variance for the assumed random effect model

Source	d.f	Sum of squares (SS)	Mean squares (MS)	Expected mean squares (EMS)
Between sires	S-1	$\sum_{i=1}^S \frac{y_i^2}{n_i} - \frac{y^2}{n}$	$\frac{SS_S}{S-1} = MS_S$	$\frac{1}{2} \sigma_k^2 + \frac{1}{2} \sigma_e^2$
Within sires	n-S	$\sum_{i=1}^S \sum_{j=1}^{n_i} y_{ij}^2 - \sum_{i=1}^S \frac{y_i^2}{n_i}$	$\frac{SS_W}{n-S} = MS_W$	$\frac{1}{2} \sigma_e^2$

S = Number of sires

n = Total number of progeny

n_i = Number of progeny of the i th sire

k = Estimated number of progeny per sire

Estimation of the Coefficient of variance components

The coefficient 'K' in the expected mean square was derived by the following formula

$$K = \frac{1}{k-1} \left(m. - \frac{\sum n_i^2}{n.} \right)$$

The components of variance, σ_s^2 (between sire component) and σ_e^2 (within sire or error component) were estimated by equating the EMS with the respective observed mean squares and substituting the estimated coefficient (K). The total variance σ_T^2 in the random model was estimated by " $\sigma_s^2 + \sigma_e^2$ ".

Estimation of heritability

Heritability was estimated for all the traits considered in this study from sire component of variance by the usual formula shown below.

$$h_g^2 = \frac{4 \sigma_s^2}{\sigma_T^2}, \text{ an estimate of } V_A, \text{ where } V_A$$

refers to that part of the total variance due to additive genetic effects.

The standard errors of the heritability estimates were derived using the formula given by Dickerson (1959) (except for slight change in the notation) as given below.

$$S.E. (h_g^2) = \frac{4 \sqrt{2/K^2 \left(\frac{MS_s}{k-1} + \frac{MS_e}{n.-k} \right)}}{\sigma_T^2}$$

Estimation of Covariance Components

The analysis was made on the same data used for estimation of variance components. Therefore, the statistical model, assumptions on the distribution of effects and 'K' value remained the same. The analysis of covariance was made as described in Table-2.

The covariance components $\sigma_g(xy)$ and $\sigma_e(xy)$ were estimated by equating the expected mean cross-products with the actual value and substituting the 'K' value. The $\sigma_g(xy)$ was directly estimated from the mean cross-product for within sires.

The following formulae were used in estimating the genetic, phenotypic and environmental correlations following Falconer (1960).

a) Genetic correlation

$$r_g = \frac{\sigma_g(xy)}{\sqrt{\sigma_g^2(x) \cdot \sigma_g^2(y)}}$$

The genetic interpretation of such estimate is

$$r_g = \frac{\text{CoV}_A + 1/4 \text{ CoV}_{AA}}{\sqrt{(\sigma_A(x) + 1/4 \sigma_{AA}(x)) \cdot (\sigma_A(y) + 1/4 \sigma_{AA}(y))}}$$

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The following formulae were used in estimating the genetic, phenotypic and environmental correlations following Falconer (1960).

a) Genetic correlation

$$r_g = \frac{\sigma_{G(xy)}}{\sqrt{\sigma_{G(x)}^2 \cdot \sigma_{G(y)}^2}}$$

The genetic interpretation of such estimate is

$$r_g = \frac{\text{CoV}_A + 1/4 \text{CoV}_{AA}}{\sqrt{(\text{V}_A(x) + 1/4 \text{V}_{AA}(x)) \cdot (\text{V}_A(y) + 1/4 \text{V}_{AA}(y))}}$$

TABLE 2. Analysis of covariance for the assumed random effects model

SOURCE	df	Sum of cross product (SCP)	Mean Cross Product (MCP)	Expected mean cross product (EMCP)
Between sires	$s-1$	$\sum_{i=1}^s \frac{(X_{i.})(X_{i.})}{n_i} - \frac{(\Sigma X_{i.})^2}{n}$	$\frac{SCP_s}{s-1} = MCP_s$	$\sigma_M^2(X) + K \sigma_S^2(XY)$
Within sires	$n-s$	$\sum_{i=1}^s \sum_{j=1}^{n_i} X_{ij}^2 Y_{ij}^2 - \sum_{i=1}^s \frac{(X_{i.})(X_{i.})}{n_i}$	$\frac{SCP_W}{n-s} = MCP_W$	$\sigma_M^2(X)$

s = Number of sires

n = Total number of progeny

n_i = Number of progeny of i th sire

K = Estimated number of progeny per sire

The standard error of the genetic correlation coefficient was obtained by using the following formula given by Falconer (1960).

$$S.E. (r_g) = \frac{1-r_g^2}{\sqrt{2}} \cdot \sqrt{\frac{S.E. (h_x^2) \cdot S.E. (h_y^2)}{h_x^2 \cdot h_y^2}}$$

b) Phenotypic correlation

$$r_p = \frac{\sigma_S (XY) + \sigma_H (XY)}{\sqrt{(\sigma_S^2 (X) + \sigma_H^2 (X)) \cdot (\sigma_S^2 (Y) + \sigma_H^2 (Y))}}$$

The method given by Snedecor and Cochran (1967) was followed for calculating the standard error of the phenotypic correlation coefficient.

$$S.E. (r_p) = \sqrt{\frac{1-r_p^2}{n-2}}$$

c) Environmental correlation

The environmental correlation was calculated using the following formula (Falconer, 1960)

$$r_e = \frac{r_p (XY) - r_g (XY) \cdot \sqrt{h_x^2 \cdot h_y^2}}{\sqrt{(1-h_x^2) \cdot (1-h_y^2)}}$$

CHAPTER-IV
RESULTS AND DISCUSSION

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Average values

The average values of the reproductive traits together with the standard errors are given in Table-3.

Perusal of Table-3 showed that the average age at first service was about 1 year 9 months and 15 days in the crossbred heifers of the present study. Age at first service indicated the maturity age in these animals. The average age at first service was lower in the reports of Kaikini *et al.* (1981a and b) in Jersey x Gir and Holstein Friesian x Gir cattle, respectively. The animals of the present study were local nondescript and Jersey crosses. The age at first service was longer in the local indigenous cattle and therefore, the crossbreds of the present study were also expected to have a longer age at first service due to 50% inheritance from the indigenous animals.

The average age at first conception was 1 year 10 months and 16 days in the present study. This average was about 35 to 37 days longer than the age at first service which was very similar to the mean insemination period in the present study.

TABLE 3. Average values of different traits and their standard errors

TRAIT	$\bar{X} \pm S.E.$
Age at first service	650.233 \pm 3.668
Age at first conception	636.216 \pm 4.777
Age at first calving	658.077 \pm 3.175
Insemination period	37.657 \pm 3.732
Number of services per conception	1.803 \pm 0.016
Gestation period	273.935 \pm 0.365

\bar{X} = Average value
 S.E. = Standard error

Lower ages at first conception were reported by Kalkini *et al.* (1981, a) in Jersey x Gir and Kalkini *et al.* (1981, b) in Holstein-Friesian x Gir, Rajan *et al.* (1981) in Holstein Friesian x Gir and Holstein Friesian x Tharparker, Nagarcentar and Rao (1982) in Holstein-Friesian x Tharparker, Brown Swiss x Tharparker and Jersey x Tharparker cows. The lower averages compared to the present study might be due to difference in breeds used for crossing. However, Kale *et al.* (1982) reported a similar average for age at first conception in Holstein-Friesian and Gir crosses.

The average insemination period in the present study was nearly one month (37.65 days). The observation of Kalkini *et al.* (1981, a and b) indicated that the insemination period was around 48 days in Jersey x Gir and 81 days in Holstein Friesian x Gir, respectively which was higher than the present results. The average insemination period in purebreds was reported to be longer than the present findings by Majumder and Prasad (1978) among others.

The observations in the present study indicated that although the indigenous x Jersey crossbreds of Grissa attained maturity a little later, the time taken to conceive from the date of maturity was shorter compared to crossbreds involving other Indian breeds.

The average age at first calving of the crossbred heifers was 2 years 7 months and 18 days in the present study, the average gestation period from age at first conception being about 273 days.

The mean age at first calving reported in literature for crossbreds produced by using different exotic and Indian breeds are numerous. The values varied to a great degree depending on the population studied and the breeds used (Sharma, 1977; Datta and Reddy, 1979; Chaturvedi *et al.* 1979; Kotayya and Rao, 1980; Yadav and Salame, 1980; Sinde, *et al.* 1981; Rajan *et al.* 1981; Taneja *et al.* 1981; Kaikini *et al.* 1981, a and b; Sharma *et al.* 1982, Nagarcentar and Rao, 1982; Kanchik *et al.* 1982; Tahir *et al.* 1983). The present results were however, within the range of values reported in different studies.

Variation in the gestation length of the crossbreds reported in literature seemed to be very less ranging from about 276-281 days (Rajan *et al.*, 1981; Taneja *et al.* 1981; Kaikini *et al.* 1981, a and b). The present average of gestation period of about 273 days was similar to the reports of the above authors.

The average number of services required for conception in the crossbreds of the present study was 1.803 ± 0.016 (Table-3). The number of services per conception was reported to be 1.55 in Sahiwal x Brown Swiss (Chaturvedi *et al.*

1979), 2.4 in Holstein Friesian x Gir and 1.85 in Holstein-Friesian x Tharparkar (Hojan et al. 1981), 1.9 in Holstein Friesian x Deshi (Kaneja et al. 1981) and 1.68 in Jersey x local indigenous cattle of Orissa (Mohanty et al. 1983). The present finding was, therefore, similar to the above reports. The number of services required per conception directly determined the insemination period and thereby the age at first conception and calving. The present averages for number services per conception indicated that the problems of repetition was no way more acute in the local crossbreds, compared to crossbreds involving other Indian breeds. The averages for this trait was 2.10 in Sahiwal (Chattopadhyay et al. 1979) 2.0 in Deshi (Kaneja et al. 1981), 1.74 in Tharparkar and 2.36 in Mariana (Kumar, 1982) Cows. The present averages in crossbreds were also lower than the above reports in purebred Indian cows. Therefore, the feeling that the crossbreds experience more reproductive problems than the local purebreds was not substantiated from the present results. Ofcourse, the present study was confined to the first calving only and subsequent calvings were not included in the study. Comments on the reproductive problems that arise after the first calving are, therefore, beyond the scope of the study.

Heritability estimates

The mean sum of squares between and within sires and the estimates of heritability for individual traits with the standard errors are tabulated in Table 4. The coefficient K was 12.367 in the present study.

TABLE 4. Mean squares in the analysis of variance and heritability values of different traits.

Trait	Mean Squares		$h^2 \pm$ S.E.
	Between sires (29)	Between progeny within sires (335)	
Age at first service	44813.325	26903.148	0.204 \pm 0.136
Age at first conception	57412.349	31149.411	0.255 \pm 0.148
Age at first calving	59041.477	30263.049	0.238 \pm 0.155
Insemination period	4986.483	5322.847	.026 \pm 0.033
Number of services per conception	0.207	0.039	0.346 \pm 0.139
Gestation period	21.468	46.593	0.204 \pm 0.126

The numbers in parentheses () are the degrees of freedom

h^2 = heritability

S.E. = standard error.

Age at first service, conception and calving

The heritability estimates of age at first service, conception and calving were 0.204 ± 0.136 , 0.255 ± 0.148 and 0.286 ± 0.156 , respectively in the present study. The estimates were of similar magnitude for the above three traits (Table-4). As the three traits are very much related, such an observation was also expected. Patel and Parekh (1982) observed a similar estimate of heritability to the present study in Jersey and Gir crosses.

Anand and Salaine (1981) observed the heritability of age at first service and calving to be 0.39 ± 0.16 in Jersey and Mariana halfbreds. Patel and Parekh (1982) reported the heritability of age at first conception as 0.11 in Holstein Friesian and Gir halfbreds. Much higher reports of heritability estimates for age at first calving were observed by Jasu and Ghal (1977) and Tomar and Tomar (1982) in Holstein-Friesian x Mariana animals. Lower reports were available in Holstein-Friesian x Sahiwal animals (Waidu and Desai, 1985).

Insemination period:

The heritability estimate of insemination period was -0.026 ± 0.083 in the present study (Table-4). The negative estimate for this trait might be due to sampling variance.

and indicated that the heritability was zero. Although, no reports on the heritability of this trait were available in crossbreds, similar estimates to the present study were made by Silva (1977) in Jersey and Guernsey and Majumdar and Prasad (1978) in Tharparker cattle.

Such a low estimate of heritability indicated that there was no additive genetic variance for this trait and improvement in environment and management would improve this trait.

Number of services per conception

The heritability estimates in the present study was 0.246 ± 0.139 (Table 4) for number of services per conception. Most of the reports available in literature for different exotic and Indian cattle were low (Logates, 1954; Rognoni and Setta, 1960; Singh *et al.* 1968; Capitelli *et al.* 1975; Silva, 1977 and Costa *et al.*, 1982). However, Tomar *et al.* (1976) observed the heritability estimate to be 0.33 in Mariana cattle similar to the present result.

Gestation period

The heritability estimate of gestation period was 0.204 ± 0.136 (Table-4) in the present study. Bastidas *et al.* (1981) reported a higher estimate in F_1 Nellore x Brahman cattle whereas, Kaulik and Byrstad (1973) reported a lower estimate in Jersey x Mariana cattle.

As the variation in this trait was very little and the average was within the limit, no attempt to reduce the gestation length would be required.

Correlations

Table-5 presents the Mean cross products of between sires and between progeny within sires in the analysis of covariance for different traits.

The coefficients of correlation between various reproductive traits in halfbred Jersey first calvers are presented in Table-6.

Age at first service and age at first conception

The phenotypic, genetic and environmental correlations were 0.909 ± 0.021 , >1 and 0.871 , respectively (Table-6). The high phenotypic and genetic correlation between the two traits as observed in this study were expected because both the traits are very similar in nature and age at first conception includes age at first service.

Age at first service and age at first calving

The phenotypic, genetic and environmental correlations were 0.902 ± 0.022 , >1 and 0.869 , respectively (Table-6). The genetic correlation was >1 which might be due to sampling error.

TABLE 5. Mean cross products in the Analysis of Covariance for different traits

Traits	MCP	df	Age at first conception	Age at first calving	Insemination period	Number of services per conception	Gestation period
Age at first service	MCP _s	(29)	48707.138	49362.207	4273.807	20.220	390.448
	MCP _w	(355)	26036.862	25463.490	-814.867	-3.869	13.415
Age at first conception	MCP _s	(29)	-	57923.331	8784.509	41.037	302.364
	MCP _w	(355)	-	30166.309	4621.123	10.707	37.459
Age at first calving	MCP _s	(29)	-	-	8872.191	41.673	421.659
	MCP _w	(355)	-	-	4697.289	10.401	75.362
Insemination period	MCP _s	(29)	-	-	-	25.449	-99.023
	MCP _w	(355)	-	-	-	14.643	9.270
Number services per conception	MCP _s	(29)	-	-	-	-	-.492
	MCP _w	(355)	-	-	-	-	-.073

MCP = Mean cross product
 MCP_s = Mean cross product of between sire component
 MCP_w = Mean cross products of within sire component
 df = Degree of freedom

TABLE 6. Coefficient of correlation between different traits

Traits		Age at first service	Age at first conception	Age at first calving	Insemination period	Number of services per conception	Gestation period
Age at first service	P	-	0.909 \pm 0.021**	0.902 \pm 0.022**	-.033 \pm 0.051	-.035 \pm 0.051	0.040 \pm 0.055
	G	-	>1	>1	-	0.539 \pm 0.259	0.487 \pm 0.360
	E	-	0.871	0.859	-	-.247	-.074
Age at first conception	P	-	-	0.984 \pm 0.009**	0.371 \pm 0.046**	0.224 \pm 0.045**	0.045 \pm 0.055
	G	-	-	>1	-	0.561 \pm 0.234	0.288 \pm 0.402
	E	-	-	0.975	-	0.112	-.027
Age at first calving	P	-	-	-	0.374 \pm 0.045**	0.222 \pm 0.045**	0.030 \pm 0.055
	G	-	-	-	-	0.553 \pm 0.229	0.352 \pm 0.141
	E	-	-	-	-	0.070	-.003
Insemination period	P	-	-	-	-	0.653 \pm 0.032**	0.001 \pm 0.055
	G	-	-	-	-	-	-
	E	-	-	-	-	-	-
Number of services per conception	P	-	-	-	-	-	-.046 \pm 0.055
	G	-	-	-	-	-	-.219 \pm 0.342
	E	-	-	-	-	-	0.017

P, G and E are the phenotypic, genetic and environmental correlation

** (P < 0.01)

The high correlation values between the three traits, Age at first service conception and calving suggested that the traits are very similar and any one of the three could be considered for selection.

Age at first service and insemination period

The phenotypic correlation between the two traits was $-.038 \pm 0.051$ (Table-6). Silva (1977) reported much higher estimates in Jersey, Guernsey and Holstein-Friesian cattle. As the sire component of variance for insemination period was negative, the genetic correlation between the two traits could not be calculated. The phenotypic correlation was low and non-significant ($P < 0.05$) which indicated that the two traits were almost independent in nature.

Age at first service and number of services per conception

The phenotypic, genetic and environmental correlations were $-.035 \pm 0.051$, 0.539 ± 0.259 and $-.247$, respectively (Table-6). No reports on these estimates in crossbreds were available in literature for comparison. Trbojevic *et al.* (1968) reported a positive and high (0.55) phenotypic correlation between the two traits in Belgrade cattle.

The phenotypic correlation in the present study was not significant indicating that the age at first service did not affect the number of services per conception.

Age at first service and gestation period

The phenotypic, genetic and environmental correlations were 0.010 ± 0.065 , 0.497 ± 0.260 and $-.074$, respectively (Table 6). No reports on these estimates were available in literature. The phenotypic correlation was not statistically significant indicating that gestation period was not affected by age at first service.

Age at first conception and age at first calving

The phenotypic, genetic and environmental correlations were 0.934 ± 0.009 , >1 and 0.975 , respectively (Table-6). No reports on these estimates were available in literature. As both the traits indicated almost the same thing, a high genetic and phenotypic correlation was quite expected.

Age at first conception and insemination period

The phenotypic correlation between these two traits was 0.871 ± 0.048 (Table-6). No reports were available in literature on this aspect. The genetic correlation could not be calculated as the sire component of variance was negative for insemination period. As the age of first conception contained insemination period in it a positive correlation was expected.

Age at first conception and number of services for conception

The Phenotypic, genetic and environmental correlations were 0.224 ± 0.045 , 0.561 ± 0.234 and 0.112 , respectively (Table-6). No reports were available in literature for these estimates. As the number of services per conception determined the insemination period which is a part of age at first conception the positive correlation was obtained.

Age at first conception and gestation period

The Phenotypic, genetic and environmental correlations were 0.045 ± 0.065 , 0.233 ± 0.402 and $-.027$, respectively (Table 6). No report was available in literature on these estimates. The low and non-significant correlation between the two traits indicated that age at first conception and gestation period were independent traits similar to the age at first service and length of gestation.

Age at first calving and insemination period

The phenotypic correlation was 0.374 ± 0.045 . The genetic correlation could not be calculated. Silva (1977) reported a similar result (0.34) in Jersey, Holstein-Friesian and Guernsey Purebreds. No reports on the crossbreds were available on this aspect. The correlation between age at first calving and insemination period was similar to the estimate for age at first conception and insemination period which was expected.

Age at first calving and number of services per conception

The phenotypic, genetic and environmental correlations were 0.222 ± 0.045 , 0.553 ± 0.229 and 0.070 , respectively (Table-6). No reports on crossbreds were available for comparison.

Vecchiotti and Gappa (1975) reported a low and negative phenotypic correlation (-0.12) in Holstein-Friesian cattle and Tomar et al. (1976) observed an insignificant genetic and phenotypic correlation in Mariana cattle. However, Singh et al. (1968) found a higher estimate (0.29 ± 0.04) in Mariana cattle. A positive correlation between the age at first conception and number of services per conception were also observed in the present study.

Age at first calving and gestation period

The phenotypic, genetic and environmental correlations were 0.080 ± 0.066 , 0.358 ± 0.141 and -0.008 , respectively (Table-6). Although no reports on crossbreds were available for these estimates, Wilcox (1963) reported a higher phenotypic correlation between the above two traits in Jersey and Holsteins (0.22 and 0.25) and Ha and Gyr (1976) reported the estimates to be very small and negative.

The variation in gestation length was very less. Therefore, although, the gestation period is a part of age at first calving the phenotypic correlation was low and non-significant.

Insemination period and number of services per conception

The phenotypic correlation was 0.663 ± 0.032 which was significant ($P < 0.01$). No reports were available in literature for comparison. As the insemination period was determined by the number of services per conception a high and positive correlation between the two traits was expected.

Insemination period and gestation period

The phenotypic correlation was 0.001 ± 0.056 (Table-6) indicating that the estimate was not different from zero which meant that the two traits were independent of each other.

Number of services per conception and gestation period

The phenotypic, genetic, and environmental correlations were $-.046 \pm 0.055$, $-.219 \pm 0.348$ and 0.017 , respectively (Table-6). No reports on these estimates either in crossbreds or purebreds were available in literature. The magnitude of the phenotypic correlation indicated that the two traits might be independent.





CHAPTER - V
SUMMARY

SUMMARY

The data over a period of four years (1976-1979) on 335 halfbred Jersey first calvers, progeny of 30 sires, were utilised to study the inheritance of some reproductive traits viz. age at first service, conception and calving, insemination period, number of services per conception and gestation period. These animals were supplied with balanced feed from one month till 28 months of age or date of first calving whichever was earlier and regular health check up, deworming and vaccination was followed under the crossbred calf rearing programme. The observations were corrected for the effect of year. Square root transformation was followed before the number of services per conception were subjected to analysis.

The average values for age of first service, conception and calving, insemination period, number of services per conception and gestation period were 650.283 \pm 8.688 days, 696.216 \pm 9.777 days, 258.077 \pm 9.179 days, 37.657 \pm 3.732 days, 1.803 \pm 0.016 and 273.936 \pm 0.366 days, respectively.

The heritability estimates for age at first service, conception and calving, insemination period, number of services per conception and gestation period were 0.206 \pm 136, 0.255 \pm 0.149, 0.286 \pm 0.156, -.026 \pm 0.033, 0.348 \pm 0.139 and 0.204 \pm 0.136, respectively. As the heritabilities for age at first

service, conception and calving were similar in magnitude it was concluded that any of the traits can be considered for any selection and breeding operations.

The genetic, phenotypic and environmental correlations between age at first service, conception and calving were high. The phenotypic correlations were highly significant ($P < 0.01$). Age at first service and each of insemination period, number of services per conception and gestation period were independent of each other due to insignificant phenotypic correlations. Age at first conception and calving were correlated with each of number of services per conception and insemination period at genotypic and phenotypic level, but these traits did not affect the gestation period significantly. Although the insemination period and number of services per conception were highly correlated, both these traits were independent of gestation period.

CHAPTER--VI
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